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ABSTRACT

An information-processing view of perceptual motor performance holds that the processes involved in perception are organizational and depend on past experiences. In motor tasks which require anticipation, an individual uses past experience to predict what may happen. Yet bias effects in perceptual judgments, including bias caused by contextual stimuli, may explain the significant differences in coincidence-anticipation performance due to stimulus speed so often found in previous research. This study observed the relationship between stimulus context and performance on an anticipatory motor skill after extended practice by skilled subjects. Two groups of 20 female college athletes each were tested for their reaction to coincidence-anticipation tasks. Following four days of practice, one group was transferred to the same stimulus speeds given to the other group. Results showed that each group improved during the training, although the pattern of improvement was not identical. Both groups demonstrated a significant tendency to respond late as well as less accurately and more variably to the slowest speed. The groups performed similarly except that the transferred group was significantly later in responding to the slowest speed. A significant speed factor for constant error and individual trial means indicated subjects were influenced by contextual stimuli. Bias effects therefore seem to persist, even after extended practice. (Author/CJ)

EFFECT OF CONTEXTUAL STIMULI ON COINCIDENCE-ANTICIPATION PERFORMANCE AFTER EXTENDED PRACTICE

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The importance of anticipation to theories of skilled behavior has long been recognized. In particular the class of anticipatory skills termed "Coincidence-Anticipation Tasks" has received much attention since these tasks embody much of the complex behavior found in life and sport skills. The performer is challenged to predict the time or place a moving object will arrive and to respond coincident with that event. Many investigators have focused their attention on motor aspects of coincidence-anticipation and therefore simplified the perceptual aspects of the task. These perceptual aspects, however, are equally important to the accuracy, direction, and variability of response, all of which have been shown to vary as properties of the stimulus change. A major interest of past investigators has been changes in the speed of the moving object.

No set of rules has emerged to accurately predict response changes with variation of stimulus speed. This may be due at least in part to <u>bias effects</u> present in the task. The involvement of bias effects in coincidence-anticipation performance has received little attention by motor skill theorists despite a long history of documentation on their role in psychophysical judgments. These effects, especially those caused by contextual stimuli, that is, stimuli preceeding and following the stimulus at hand, may explain the significant performance differences in directional error so often found when stimulus speed is varied on a trial-by-trial basis. Such variation has been introduced into many coincidence-anticipation paradigms to more accurately reflect life and sport skills wherein the speed of the task stimulus is rarely known before it is visually monitored.

Laabs (1979) has recently outlined several bias effects. The most common is the range effect wherein small stimulus intensities are overestimated and large intensities underestimated. Another common effect relevant to coincidence-anticipation performance is the assimilation effect. The performer would respond in this case in the direction of the prior stimulus speed. A contrast effect would be the case wherein the response is in the direction opposite that of the prior stimulus level. The presence of all three types of bias effects has been detected in previous research using coincidence-anticipation tasks.

Given that bias effects may explain, at least in part, variations in response direction with trial-by-trial changes in the stimulus speed of coincidence-anticipation tasks, several questions arise. Do bias effects persist after extended practice by skilled performers? Does the introduction of "new" speeds heighten bias effects? If performers, through extended practice, develop rules (or a schema) for judging stimulus speeds, extended practice would eliminate the effects of contextual stimuli. Such rules could also be called upon for judgments involving slightly "new" stimuli. In the present study, it was hypothesized that performance on a coincidence-anticipation task over an extended time would eliminate any bias effects present in initial task trials and that transfer to slightly different speeds after extended practice would not yield bias effects.

The subjects of this study were forty women, all intercollegiate athletes between 18.2 and 21.7 years of age. Each was paid $7.00 to participate. The coincidence-anticipation apparatus used was a Bassin Anticipation Timer. This apparatus simulates a moving stimulus with a runway of sequentially lit L.E.D. lamps. The subject faced the middle of the runway so that the light "moved" horizontally from left to right. The subject's response was a push of a hand-held button with the preferred thumb. Each subject was tested on each of four days with a 5-day span as outlined in Table 1.

Table 1

Testing Procedure

	CONTROL GROUP	TRANSFER GROUP
	Visual Skills Profile	Visual Skills Profile
DAY 1	3 Blocks of 30 Trails Each 10 Trails/Speed/Block 2, 3, and 4 MPH Warning Times: 1.5, 2.0, or 2.5 sec. Interblock Rest: 2 min. Standardized Stimulus Speed Schedule	3 Blocks of 30 Trials Each 10 Trials/Speed/Block 2, 4, and 6 MPH Warning Times: 1.5, 2.0, or 2.5 sec. Interblock Rest: 2 min. Standardized Stimulus Speed Schedule
DAY 2	3 Blocks of 30 Trials Each 2, 3, and 4 MPH	3 Blocks of 30 Trials Each 2, 4, and 6 MPH
DAY 3	3 Blocks of 30 Trials Each 2, 3, and 4 MPH	3 Blocks of 30 Trials Each 2, 4, and 6 MPH
DAY 4	3 Blocks of 30 Trials Each 2, 3, and 4 MPH	1 Block of 30 Trials 2, 4, and 6 MPH 2 Blocks of 30 Trials Each 2, 3, and 4 MPH

Subjects were required to pass a visual skills profile then received standardized instructions stressing that the response come at the same time the light arrived at the marked end of the runway.

On each day subjects were given 3 blocks of 30 trials each, 10 at each of 3 stimulus speeds. The Control Group anticipated speeds of 2, 3, and 4 MPH throughout the 360 trials administered over 4 days. The Transfer Group trained at 2, 4, and 6 MPH for 3 days and the first block of Day 4 before transferring to the same stimulus speeds given the Control Group. The standardized stimulus schedule was identical for the last 2 blocks for the two treatment groups. Following each trial the subject was given her score and its direction in order to increase the motivation to perform well over the 360 trials.

RESULTS

The training trials were initially examined by a speed by trial block ANOVA for each group separately, as the groups trained at different stimulus speeds. Trial block was a significant factor in the Control Groups' performance in terms of constant, absolute, and variable error, as pictures in Figure 1. Stimulus speed was also a significant factor in terms of constant, absolute, and variable error. Mean error shows that responses to the slowest stimulus, 2 MPH, were least accurate, more variable, and late in direction while responses to 3 and 4 MPH stimuli tended to be early.

The interaction effect was also significant. In terms of constant error the interaction seemed to reflect initial late responses to 2 MPH stimuli and early responses to 4 MPH stimuli which both approached zero error over trials. Absolute and variable error means, as presented in Table 2, showed that accuracy decreased and variability increased in the 8th and 9th blocks for 2 MPH trials only.

Table 2

Mean Stimulus Speed Scores During the Training Trials

	Control Group						Transfer Group					
	2 MPH		3 MPH		4 MPH		2 MPH		4 MPH		6 MPH	
Measure	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Constant Error	.010	.025	-.008	.023	-.017	.025	.015	.021	-.010	.021	-.015	.024
Absolute Error	.043	.014	.039	.014	.040	.016	.043	.011	.036	.021	.038	.013
Variable Error	.045	.014	.043	.017	.042	.015	.044	.012	.038	.013	.039	.013

The pattern was similar for the Transfer Group, as shown in Figure 2. Performance became significantly more accurate and less variable and showed less directional tendency, after the third block. Stimulus speed was a significant factor and followed the same pattern as the Control Group. The interaction was significant for constant and variable error. The pattern here also followed that of the Control Groups'.

In the analysis of the Common Trials, a Group by Speed by Trial Block ANOVA was calculated. Group and block were not significant factors, but speed was significant within a group by speed by block interaction effect for constant, absolute, and variable error. The constant error means (see Table 3) indicated a similar performance between the groups at the various stimulus speeds except that the Transfer Group tended to respond very late to the 2 MPH stimulus <u>in the first block</u>. The absolute error and variable error means reflected a tendency for the Control Group's error scores at the various speeds to converge in the second block while the Transfer Group's means diverged.

Table 3

Mean Stimulus Speed Scores During Common Trials

	Speed					
	2 MPH		3 MPH		4 MPH	
Measure	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Constant Error	.010	.033	-.008	.041	-.006	.039
Absolute Error	.037	.027	.031	.027	.031	.025
Variable Error	.040	.012	.036	.014	.035	.013

The constant error individual trial means over the last 30 common trials were also plotted and appear to indicate the influence of the preceeding stimulus' speed (see Figure 3). Within these 30 trials, the 2 MPH stimulus was presented 10 times, preceeded by either a 3 or 4 MPH stimulus. On 10 of these 2 MPH trials the Control Group responded later than on the preceeding 3 or 4 MPH trial. The same was true of the Transfer Group in 9 of 10 cases. A similar effect in the opposite direction was present when 4 MPH trials were preceeded by 2 MPH trials. Of the 4 trials in which this occurred for each group the response was earlier in every case: each group responded earlier on 4 of the 4 trials. This tendency was not present when 4 MPH stimuli were preceeded by 3 MPH stimulus.

DISCUSSION

It was hypothesized that extended practice would eliminate any bias effects present in this coincidence-anticipation task. It was found, however, that while both groups reduced their directional error with continued training, responses to the slowest stimulus speed remained late throughout training and those to the faster speeds

remained early. Further, when the experimental group was transferred to a new stimulus schedule, they initially responded even later to the 2 MPH stimuli, despite their having seen this speed throughout training. It appears that the generally slower set of speeds in the transfer trials led the transfer group to overestimate the slowness of the 2 MPH stimulus to an even greater extend than on their own previous responses. This effect is similar to those psycho-physical judgments noted by Poulton (1979) in transferring between ranges of stimuli.

The analyses appears to indicate, therefore, that a contrast effect was present in the early training trials, persisted throughout training, and was accentuated in the transfer group when they were transferred to a new set of stimulus speeds.

It is interesting to note that the distinction in the effects seems to be between the slowest speed and the other two speeds. This suggests the performer may not perceive the middle speed as being in the middle, a suggestion not surprising in light of research on psycho-physical judgments of the subjective midpoint (Poulton, 1968).

As outlined earlier, range, assimilation, and contrast effects have all been found in coincidence-anticipation studies. A contrast effect was obtained in one previous study (Haywood, 1980) and the present investigation. Both studies used an apparent motion apparatus, Lafayette's Bassin Anticipation Timer. Three investigators (Haywood, 1977; Pavlis, 1972; Stadulis, 1972) have noted an assimilation effect and all three used an actual moving object or a TV image which appeared continuous to the naked eye. The effect exhibited in any given case may be a function of the type of stimulus used. Alderson and Whiting (1974) obtained a range effect using an actual moving object, but the terminal portion of the stimulus' path was occluded.

The present study involved experienced athletes who were subject to the contrast effect in their initial trials and who continued to be influenced by the effect throughout training, even within two different ranges of stimuli. If the performers developed a set of rules, or a schema, for responding to the stimuli, it appears they were unable to do so independently of the contrast effect. Poulton (1968) has reviewed psychophysical judgments which apply to experienced performers and suggested that one may initially "calibrate" oneself on an initial judgment. Further judgments will then be consistent with the initial judgment. In summary, the present findings do not support the hypothesis that extended practice eliminates bias in coincidence-anticipation judgments, including judgments of "new" stimuli. It appears that any schema formed for such judgments are subject to bias effects perhaps by virtue of an initial calibration of the performer under the influence of a bias effect.

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